International Journal of Agricultural Science and Research (IJASR)
ISSN(P): 2250-0057; ISSN(E): 2321-0087
Vol. 7, Issue 3, Jun 2017, 29-36

TRANS STELLAR
•Journal Publications •Research Consultancy

DESIGN AND DEVELOPMENT OF LOW COST GREENHOUSE TO RAISE DIFFERENT CULTIVARS"

G. RAJENDER, K. SUSHANTH, K. MITHUN, B. DEVENDER, D. RAJU & K. ANOOSHA

Department of Agricultural Processing & Food Engineering, CAE, Sangareddy

ABSTRACT

The cultivar growing technology under the low cost greenhouse may occupy an important role in Indian Agriculture in the future years. The low cost greenhouse ensures the year round growing of different cultivar varieties. This may ensure timely availability of cultivars with good vigour. To establish a poly house, the farmer has to invest Rs. 900-1000 for one m^2 area using tubular framed structure. To reduce the installation rate of greenhouses, a low cost greenhouse having an area of 50 m^2 was constructed (10 m × 5 m × 3.5 m) with locally available casuarina wood coated with coal tar was used as structural material and bamboos were used as frame work. Wooden strips with nails were used to make the poly grip assembly. UV stabilized PVC transparent sheet was used as outer cover in place of traditional glass sheets. The drip system was installed and costs around Rs. 23811.16/-. The cost for m^2 area is around Rs. 467.6/-, whereas to construct a greenhouse for naturally ventilated tubular structure is Rs 1060/- per m^2 (MIDH). So the cost was reduced to about 56 % by using locally available material.

KEYWORDS: Controlled Environmental Agriculture, Low Cost Greenhouse, Locally Available Material & Cladding Material

Received: Mar 28, 2017; **Accepted:** Apr 17, 2017; **Published:** Apr 19, 2017; **Paper Id.:** IJASRJUN20174

Original Article

INTRODUCTION

The greenhouse is now better understood as a system of controlled environment agriculture (CEA), with a precise control of air, temperature, humidity, light, carbon dioxide, water and plant nutrition (Tiwari, G. N., 2003) [15]. The main purpose of greenhouse technology is to provide a good growing environment for successfully growing high quality plants round the year. The growing of fruits, flowers and vegetables under greenhouse is common practice.

The newly formed Telangana state with periphery of ten districts is having net cultivated area of 4.0 M ha, of which 60% is rain-fed. The state principally falls under semi-arid tropical climate. The soils are of predominantly red earth's which is most suitable for the production of horticultural crops. With diversified three agro-climatic zones, horticultural production and productivity accounts to be 10.86 lakh ha and 121.57 lakh MT, respectively. The average annual rainfall is 850 mm, receiving major share from South-West monsoon. In spite of conducive and favorable climate in Telangana State, protected cultivation is yet to gear up for the want of technology know how, capacity building and transfer of technology. With prevailing semi-arid tropical climate, there is a potential scope for greenhouse cultivation, especially for remunerative and export oriented crops. Government of Telangana is investing crores of rupees on the poly house construction and its maintenance. To establish a poly house, the farmer has to invest 900-1000/- Rs. for one m^2 area using tubular framed structure. The farmers who could not avail the subsidy, it is a back drop and burden for them to establish such green houses. To

overcome these problems and to suit to farmer's economy in construction of these greenhouses in their field, a low cost wooden structure has been designed and developed in this present study.

DESIGN OF GREENHOUSE

Overall Dimensions of Low Cost Greenhouse of Area 50 m^2

- Length of greenhouse = 10m
- Width of greenhouse = 5m
- Distance between Side poles = 2.5m
- Distance between centre poles = 2.5m
- Depth of foundation = 0.6 m
- Height up to gutter = 2.0 m
- Height up to top = 3.5 m
- Top ventilation = 0.5 m
- Side ventilation = 0.5 m
- The length of line joining between left side pole to central pole = 2.7 m
- The length of line joining between right side pole to central pole = 2.91 m
- Angle between line joining towards central pole to left side pole = 22^0
- Angle between line joining towards central pole to right side pole = 31^0

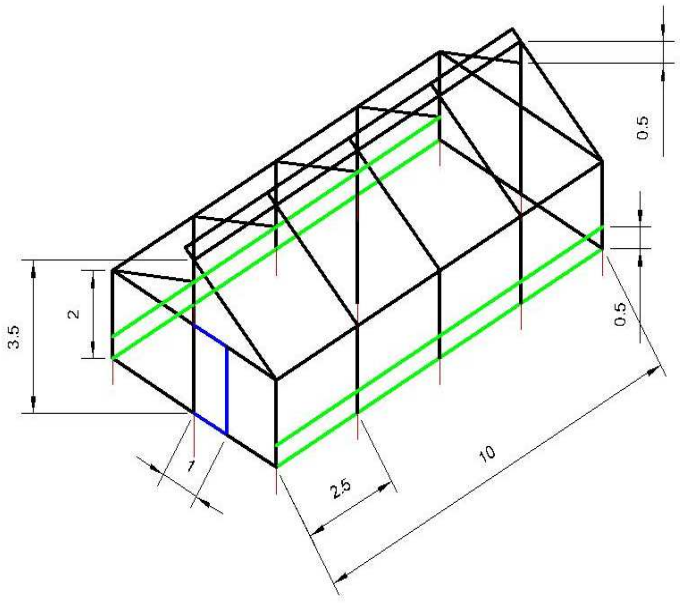

Figure 1: Line Diagram of Low Cost Greenhouse

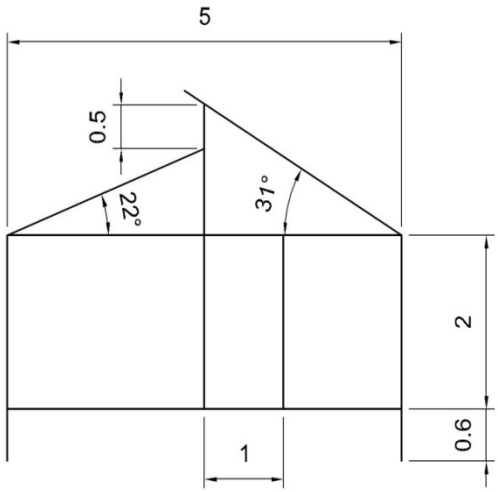

Figure 2: Side View of Greenhouse

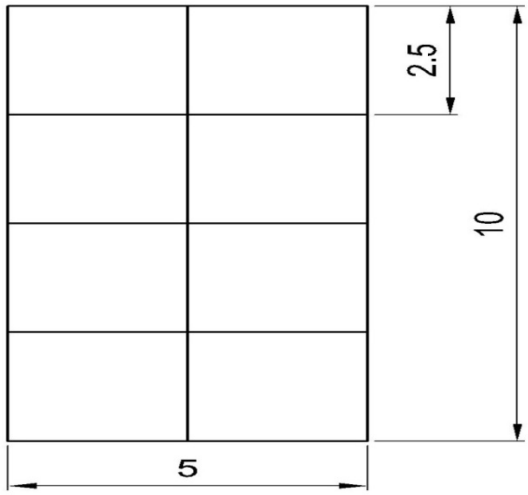

Figure 3: Front View of Greenhouse

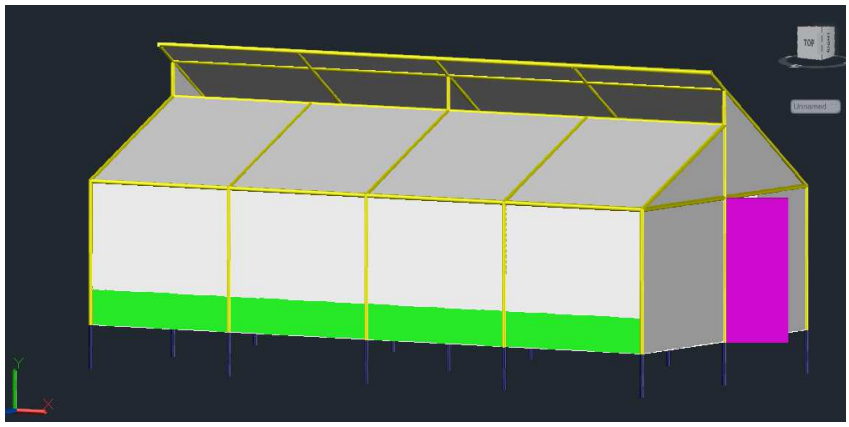

Figure 4: Isometric View of Greenhouse

MATERIALS REQUIRED

The following materials are required to construct the low cost greenhouse.

- **Wooden Posts**

The wooden posts of instance casuarina wood were used. The average diameter considered for the posts as 6.2 cm. These wooden posts are used for main structure like side posts and central posts. The height of the side posts and central posts would be 3 m and 4.2 m long respectively. A proper selection of these posts will help in maintaining the symmetry of the structure.

- **Bamboos**

Usually a light weight, small diameter bamboos were used. The average diameter of the bamboos taken was 6.2 cm. The length of bamboos used was 5.5 m. These bamboos were generally used for making the frame of the green house.

- **Coal Tar**

Wood, which comes in contact with the soil, is easily susceptible to decay. So, special treatment was given to the wood. Coal tar was applied to the wood which gives the protection against the decay and against termites. Even natural

decay resistance woods, such as redwood and cypress should be treated.

- **Cladding Material**

UV stabilized 200-micron polyethylene of size 140 square meters are used for 50 square meters of floor area. Size of cladding material will depend upon side areas and frame area of the greenhouse.

- **Insect Proof Net**

Insect proof net was used to prevent the entry of insects into the greenhouse. The net was covered along the side and top ventilations. Size of the insect proof net will be 15 square meters for 50 square meters of floor area which is equivalent to ventilation area.

CONSTRUCTION

The study was conducted in the premises of College of Agricultural Engineering, Kandi, besides IIT Hyderabad, Sangareddy, covering an area of 10 m x 5 m. The climate comes under Semi-arid tropics. The average rainfall is in the range between 850 mm to 950 mm. The major contribution of rainfall is from South-West monsoon. Out of which 80 % is received during the months of June to October. The construction and experimentation was carried during January to May, 2016.

All wooden posts were applied with coal tar to prevent from termite and moisture attack and wrapped the poles (posts) with 1000 gauge black LDPE film with the help of polypropylene ropes. The centre posts were made to stand firm and straight in the length-wise direction. All the holes were dug of about 600 mm depth and posts were inserted in holes and filled with cement concrete groute (with the proportion of 1:3). One bay structure was completed first and the subsequent bays were constructed one after the other. Side posts were kept in position as per design.

Frame work was very essential and was done by using low weight smaller diameter bamboos. It was difficult to attach or fix the bamboos to the wooden posts. There were so many techniques for fixing the bamboos on the wooden posts. One of the techniques was by using welded GI pipe with nut and bolt mechanism. This mechanism was chosen because; GI pipe has more strength and ability to overcome the external loads. Using nut and bolts, the bamboos and wooden posts were firmly fixed with the help of welded GI pipe. The holes required for inserting nut and bolt mechanism were drilled using drilling machine.

Bamboos Fitted into MS Pipes with Nut and Bolt Mechanism

In this mechanism,3 no’s MS pipes of 63 mm dia. are welded together with nut & bolt arrangement. Welding should be done based upon the angle between the side post and line joining the side and central posts and it’s also concern with the number of attachments to the particular post. Nut & bolts are used for fitting the wooden posts and bamboos in the GI pipe as shown in Figure 5. The holes for nut & bolts are drilled by the drilling machine.

Figure 5: Bamboos Fitted into MS Pipes with Nut and Bolt Mechanism

The GI pipes of two different diameters were welded together with an angle which was based upon the design and layout of the system. Diameter of pipes will depend upon diameter of bamboos and wooden posts. These welded GI pipes were provided for each wooden posts and bamboos of greenhouse. After then, bamboos were laid with an angle from side posts to centre posts. Nuts and bolts are tightened well together by using spanners.

Figure 6: Frame Work

Wooden Strips with Nails- Poly Grip Mechanism

Polyethylene film was wrapped; rolled on the wooden posts and bamboos tightly by wooden strips placed over and with gentle hammering to fix the cladding material on the bamboo framework. Typical dimensions of the wooden strip were 1" × 0.5" (breadth × height). Overall length of wooden strips will depend upon the length of wooden posts and bamboos. Nails of size 1.5" will be used to fix the wooden strip on the cladding material by gentle hammering as shown in Figure 7.

Figure 7: Wooden Strips with Nails - Poly Grip Mechanism

20×20 cm wide trenches were dug along the greenhouse, throwing the soil outwards so that it was used for burying the edge of insect proof net. It was made sure that the soil used for covering this film was free from rocks or any sharp objects. Cladding the structure was done using UV stabilized Polyethylene film. Sharp objects can damage the film rendering it useless. Proper care was taken in rendering all the surface contact with the film are smooth.

Red soil was used in greenhouse. The beds were laid about 50 cm width and 20 cm height along the length of the greenhouse. The drip system was installed and drip laterals were laid on the beds.

Figure 8: Laying of Drip System in Greenhouse

COST OF GREENHOUSE

Table 1: Cost Analysis of Low Cost Greenhouse (10 M × 5 M × 3.5 M)

S. No	Item	Specification	Quantity	Approx. Rates(Rs)	Approx. Cost(Rs.)
1	Casurina wood	7.5 cm dia, 4.2 m long 7.5 cm dia, 3.0 m long	03 No's 10 No's	@ 180/ piece @ 160/ piece	540/-1600/-
2	Bamboo	6.2 cm dia, 5.5 m long	24 No's	@ 110/ piece	2640/-
3	M.S. Pipe	6.3 cm dia, 6 m long	2 No's	@ 600/ piece	1200/-
4	Polyethylene sheet	200 microns, UV stabilised	140m^2	@ 60/ m^2	8400/-
5	Installation of Drip System				5000/-
6	Miscellaneous				1000/-
Sub – Total					**20380/-**
7	10 man-days @ 300				3000/-
Grand Total					**23380/-**

CONCLUSIONS

Generally, the cost for construction of Greenhouse for naturally ventilated tubular structure is Rs 1060/- per m^2 which is a bane to the rural, small and marginal farmers who are occupying around 60% of the total farmer population in India. Considering economic condition of farmers, requirement and adaptability, 'Low Cost Greenhouse of area 10m×5m×3.5m was developed with locally available material 'casuarinas wood' and 'bamboo' has a structural material. Foundation material was made out of casuarina wood and treated with Aldrin in order to prevent the attack of termites. UV stabilised plastic sheet was used for covering the structure. This wooden greenhouse of an area of 50 m^2 costs around Rs 23380/-. The cost for m^2 area is around Rs.467.6/-. The cost for construction of naturally ventilated wooden greenhouse by 56%.

REFERENCES

1. *Alam, A. 1988. Surface covered cultivation – its attributes and relevance under Indian conditions. Paper presented at the summer meeting of ICAR, New Delhi.*
2. *Alward, Ron and Andy Shapiro. 1980. Low-Cost Passive Solar Greenhouses: A Design and Construction Guide. Butte, Montana: National Center for Appropriate Technology.*
3. *Ashish Yadav et al. 2015. Low cost plastic shelters for year round vegetable production in north eastern hill regions. New age protected cultivation. Published bi-annually, Vol. 1(2).*
4. *Baudoin, W. O. 2002. Greenhouse constructions for small scale farmers in tropical regions. Acta Hort. 578, ISHS.*
5. *Benedict, W. G. 1964. Low cost efficient plant growth structures, Canadian journal of plant sciences, Vol. 44.*
6. *Biradar, M. S. and Khan, M. M. 1996. Performance of gerbera varieties under low cost protected greenhouse. Thelalbaugh 41, 46-52.*
7. *Coleman, E. W. 2014. The design and management of moveable pipe-frame, plastic-covered greenhouses for year-Round organic vegetable production without supplementary heating. Acta Hort. 1041, ISHS.*
8. *Harnett, R. F. and Bowman G. E. 1979. Comparison of greenhouse types and their orientation. Experimental Horticulture 31:59–66.*
9. *Hoffmann, S. and Waaijenberg, D. 2002. Tropical and subtropical greenhouses – a challenge for new plastic films. Acta Hort. 578:163-169.*
10. *Pandey, V. K. et al. 2004. Low cost greenhouse technology for vegetable cultivation in Chhattisgarh Region. Plant Archives. 4(2), pp: 295-301.*
11. *Pritam, K. and Yadav, R. K. 2015. Enhancing small farmers' income through Off-season vegetable production under temporary low height greenhouse protections, New Age Protected Cultivation. Published bi-annually, Vol. 1(2).*
12. *Saikia, J. et al. 2001. Off season production of cucumber inside low cost greenhouse. Annals of Biology. 17(1), pp: 61-64.*
13. *Singh, J. K. 1968. Materials for greenhouse construction. Paper presented at summer meeting of ICAR, New Delhi.*
14. *Singh, P. K. et al. 2012. Effect of inter-row spacing and pruning on yield, water use and economics of tomato production under naturally ventilated bamboo greenhouse. Pantnagar journal of research. Vol. 10(1).*
15. *Tiwari G. N. 2003. A Text book of "Green house Technology for controlled Environment" Alpha Science Publisher.*